Sheet No: 6.5.1

BEFORE READING THIS DATA SHEET PLEASE REFER TO THE INTRODUCTION

6.5 Compartment floors

Main application in respect to this *Design Guide:*

Maintaining a horizontal barrier to prevent fire spread.

FUNCTION OF COMPARTMENT FLOORS

- To maintain a load-bearing capacity under fire conditions for the duration defined in Table 2.2 of the *Design Guide*, thus ensuring that the building structure maintains its stability for a reasonable/ acceptable period.
- To maintain a load-bearing capacity for the duration defined in Table 2.2 of the *Design Guide*, thus ensuring that the circulation/escape routes remote from the fire storey remain accessible.
- To provide an imperforate barrier, whose integrity is ensured for the duration defined in Table 2.2 of the *Design Guide*, against vertical fire spread.
- To restrict an increase in temperature on the upper unexposed surfaces of the floor, thereby preventing the spread of fire via conducted heat for the period defined in Table 2.2 of the *Design Guide*.
- To restrict smoke spread between floors, ideally for a period equal to integrity.
- Not to be capable of spreading flaming on its lower surface (i.e. the ceiling of the room underneath).
- Not to contribute unduly to the growth and development of fire within the room underneath.
- To withstand the loading and deflection to be experienced in use and during fire exposure whilst maintaining the requirements above.
- To maintain the integrity of the barrier to fire, whilst accommodating the passage of services and ducts through the compartment floor. To achieve smoke restriction, all penetrations shall be fully sealed.
- To maintain the separating performance over the lifetime of the building, in respect of realistic impact and/or ambient conditions.

EVIDENCE OF FIRE PERFORMANCE

The evidence of performance shall comply with the following;

- **Fire resistance performance (load-bearing capacity).** The ability of the floor assembly (or its constituent components in combination) to maintain its load-bearing capacity and resist undue deflection, deformation and collapse shall be verified by test or engineering assessment evidence of performance in accordance with BS 476: Part 21[1g], EN 1365 Part 2[27b], under conditions appropriate to the end use of the floor and preferably supported by a Field of Application Report identifying any restrictions in use.

IMPORTANT

THESE DATA SHEETS ARE ONLY INTENDED TO GIVE GENERIC INFORMATION.

DATA ON PROPRIETARY PRODUCTS MUST BE OBTAINED FROM THE MANUFACTURERS

For timber floors suitable performance against this criterion may also be verified by appropriate structural fire engineering design codes in accordance with BS 5268: Part 4: section 4.1[5a]. Such design must be checked/assessed by a competent person.

- **Fire resistance (integrity).** The ability of the floor assembly (or its constituent components singly or in combination) to maintain a barrier against fire spread, flaming on the unexposed face and/or collapse shall be verified by test evidence or engineering assessment in accordance with BS 476: Part 21[1g], EN 1365 Part 2[27b], under conditions appropriate to the end use of the floor and preferably supported by a Field of Application Report identifying any restrictions in use.
- **Temperature rise (insulation**). The ability of the floor assembly (or its constituent components singly or in combination) to resist the transfer of conducted heat to the unexposed surface to such an extent that excessive temperatures are reached on the upper surface. This shall be verified by test or engineering assessment evidence in accordance with BS 476: Part 21[1g], EN 1365 Part 2[27b], under conditions appropriate to the floor's end use and preferably supported by a Field of Application Report identifying any restrictions in use.
- **Smoke resistance.** The floor assembly shall have at least one impermeable face and the method of fixing shall be such that no gaps exist.
- **Surface spread of flame and contribution to fire growth.** The exposed surface of the floor, i.e. the soffit of the ceiling underneath, shall achieve a surface spread of flame classification of Class 1 as defined in BS 476: Part 7[1d]. The same surface shall also achieve a fire propagation Index of not more than 12 and a sub-index of not more than 6 when tested to BS 476: Part 6[1c]. Note that the combination of these various performance parameters is described as being Class 0 in the Approved Document B to the Building Regulations 1991 England and Wales[29].

  To comply with the requirements of Part 2.2 of this *Design Guide*, the exposed surface of the floor (i.e. the ceiling under) shall be designated as being non-combustible, BS 476: Part 4[1b], or of limited combustibility, as defined by BS 476: Part 11[1e]. Class 0 surface on a non-combustible substrate is also permissible.
- **Loading and deflection.** The compartment floor shall be so constructed such that the occurrence of a deflection of span/30 during fire conditions shall not cause the opening of gaps or undue cracks which could permit fire spread, nor shall such deflection cause the transfer of loads (direct or thermally induced) from the floor to adjacent non-loadbearing members such as partitions and walls. Compliance with the requirement shall be demonstrated through a combination of an engineering awareness of load paths and fire test or engineering assessment evidence in accordance with BS 476: Part 21[1g], EN 1365 Part 2[27b] together with an associated Field of Application Report.

- **Accommodation and passage of services.** Evidence shall be available to verify that the penetration of the compartment floor by services will not impair the various fire performance parameters described above.
- **Durability.** Evidence shall be available to verify that the materials used in the construction of the compartment floor are not going to be adversely affected by ambient conditions and, if appropriate, abuse (e.g. low energy impacts) during the anticipated life of the floor.

Overview of compartment floors

A floor is an assembly which consists of a combination of one or more of the following components (see also Figure 1):

1. Lower surface (ceiling)
2. Structural supports
3. In-fill materials
4. Upper surface (flooring)

The potential contribution of each component of the floor to the overall fire performance of the construction needs to be evaluated. It is important to remember that evaluation of performance is based upon fire exposure from beneath the floor and thus the exposure conditions may be summarised as follows;

Lower surface (ceiling) - always directly exposed to fire*

Structural assembly - may be directly exposed to fire

In-fill materials - generally not exposed directly to fire

Upper surface (flooring) - generally not directly exposed to fire

Floor components

1. Lower surface (ceiling surface)

1.1 Gypsum based boards and skim

1.2 Lath and plaster

1.3 Concrete

1.4 Permanent steel formwork

1.5 Permanent woodwool shuttering

1.6 Proprietary suspended ceilings

1.7 Timber ceilings

1.8 Proprietary boards

1.1 Gypsum based boards and skim

The fire performance of gypsum boards is a function of board thickness and fixing details. The thickness of board necessary will depend upon the tolerance of the structure being protected. Gypsum boards incorporating reinforcement are normally able to provide a similar level of protection at a reduced thickness

** Care must be taken to ensure that the protective contribution made by this membrane is not negated by fitting such as recessed lighting fittings that are not protected themselves. If such items are installed then the structural assembly will be unduly exposed to the fire conditions. Only tested light fittings should be permitted to be used.*

which may be important when weight is a consideration. Boards should be fixed directly to the structural members through a fillet if the temperature of the structural member is critical. The following fixings for structural boards are recommended:

Thickness of board	Nail length	Spacing
9.5mm	30mm	150mm centres
12-15mm	40mm	150mm centres
19-25mm	60mm	150mm centres

Different fixing techniques may be used, provided that the boards are held with an equivalent degree of fixity to that upon which the evidence of performance is based. Gypsum boards incorporating reinforcement are typically able to provide a significant level of protection at a reduced thickness which may be important when self weight is a consideration.

Fire performance data

- **Fire resistance (integrity).** Low propensity to cracking, but not totally immune; normally considered good. Reinforced gypsum boards have a higher integrity potential than standard grade board, particularly when used horizontally. (☆☆☆☆)
- **Temperature rise (insulation).** Gypsum boards have excellent resistance to temperature rise until all of the water of vaporisation is driven off. (☆☆☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** If undamaged, boards may be considered impermeable. Joints need to be filled and taped according to manufacturer's proven methods to maintain this characteristic. (☆☆☆☆)
- **Loading and deflection**. Only capable of withstanding limited deflection and design details need to be given to meet this requirement. Reinforced board is more able to tolerate deflection. (☆☆)
- **Ability to accommodate services.** Normally rigid enough to accept sealants around single services, but support would be needed to restrain closing devices and sealing systems. (☆☆☆)
- **Durability.** Not suitable for use in wet conditions, but generally may be considered durable with resistance to reasonable impacts. (☆☆☆)

1.2 Lath and plaster

Existing ceilings of 15-22mm plaster on wood lath may possibly contribute up to 20 minutes to the fire resistance of a timber floor under BS 476 temperature and pressure conditions. Greater thicknesses of plaster may not be beneficial in increasing protection levels, temperature and pressure as the increased self-weight may promote failure. However, condition and key is critically important and a visual inspection and engineering assessment by a competent person is required, before any fire performance may be assumed. *In the absence of the above, the default assumption should be that lath and plaster is ineffective in fire terms.*

Fire performance data

- **Fire resistance (integrity).** High propensity to cracking when aged; must be inspected and evaluated on a case by case basis. (☆☆)
- **Temperature rise (insulation).** Lath and plaster ceilings have good resistance to temperature rise until all the water is driven off. (☆☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** If undamaged, lath and plaster ceilings may be considered impermeable. (☆☆☆☆☆)
- **Loading and deflection**. Capable of withstanding reasonable deflections. (☆☆☆☆)
- **Ability to accommodate services.** Normally difficult to penetrate and prepare controlled opening for the acceptance of sealants around single services. Support would be needed to restrain closing devices and sealing systems. (☆☆)
- **Durability.** Not suitable for use in wet conditions, but generally may be considered durable to reasonable impacts. (☆☆☆)

1.3 Concrete

The underside of a compartment floor might simply consist of a concrete soffit. Such a ceiling soffit may be smooth or profiled. Concrete ceilings are an integral part of the concrete floor structure and the fire resisting properties should be evaluated accordingly.

Fire performance data

- **Fire resistance (integrity).** Little propensity to cracking. (☆☆☆☆☆)
- **Temperature rise (insulation).** Good resistance to temperature rise. (☆☆☆☆)
- **Surface spread of flame.** Class 0 and non-combustibility. (☆☆☆☆☆)
- **Smoke resistance.** Completely impermeable. (☆☆☆☆☆)
- **Loading and deflection.** Generally structurally capable of withstanding deflection. (☆☆☆☆☆)
- **Ability to accommodate services.** Rigid enough to accept sealants around services, without needing support to restrain closing devices and sealing systems. (☆☆☆☆☆)
- **Durability.** Highly durable. (☆☆☆☆☆)

1.4 Permanent steel formwork

Seldom exposed as a ceiling surface, except occasionally in industrial or plant areas. Widely associated with a cast in-situ concrete flooring system, with related fire performance properties.

Fire performance data

- **Fire resistance (integrity).** No propensity to cracking. (☆☆☆☆☆)
- **Temperature rise (insulation).** In isolation poor resistance to temperature rise, but concrete substrate acts as an effective heat sink. (☆☆☆☆)

- **Surface spread of flame.** Class 0 and non-combustible. (☆☆☆☆☆)
- **Smoke resistance.** Completely impermeable. (☆☆☆☆☆)
- **Loading and deflection.** Generally structurally capable of withstanding deflection. (☆☆☆☆☆)
- **Ability to accommodate services.** Rigid enough to accept sealants around services, without needing support to restrain closing devices and sealing systems. (☆☆☆☆☆)
- **Durability.** Durable. (☆☆☆☆☆)

1.5 Permanent woodwool shuttering

Typically encountered only in existing buildings and a hangover from a construction technique used several decades ago. A concrete floor was cast in-situ onto woodwool formwork, which was left in place and coated with a skin of plaster. Difficulties associated with the construction technique give rise to problems of poor compaction and air pockets within the floor structure. This directly reduces the reliability of such floors under fire conditions. Special care is needed, if such a flooring system is to be retained as a compartment floor. A full inspection by a competent person should be sought.

Fire performance data

- **Fire resistance (integrity).** High propensity to cracking when aged; must be inspected and evaluated on a case by case basis. (☆)
- **Temperature rise (insulation).** Reasonable resistance to temperature. (☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility, by virtue of the plaster skim. (☆☆☆☆☆)
- **Smoke resistance.** If undamaged, ceiling may be considered impermeable. (☆☆☆☆☆)
- **Loading and deflection**. Capable of withstanding reasonable deflections. (☆☆☆☆)
- **Ability to accommodate services.** Normally difficult to penetrate and prepare controlled opening for the acceptance of sealants around single services. Support would be needed to restrain closing devices and sealing systems. (☆☆)
- **Durability.** Not suitable for use in wet conditions, but generally may be considered durable to reasonable impacts. (☆☆☆)

1.6 Proprietary suspended ceilings

A large number of proprietary ceiling systems may be used to contribute to the fire performance of the floor assembly. Care must be taken to ensure that such systems are assembled strictly in accordance with a strict specification, whose fire performance has been verified by test or assessment by a competent person. *Often, light fittings etc. are installed that can eliminate the contribution to fire resistance that a suspended ceiling can make.* Many proprietary ceiling systems have been verified for their contribution to the fire resistance rating achieved by a steel beam which is protected by the ceiling. Should such a ceiling system be used in conjunction with a timber beam assembly, then its expected contribution to fire performance may be significantly less than that indicated by the results of the steel beam test. The scope of the Field of Application Report accompanying the Fire Test Report needs to be studied carefully to ensure compatibility with associated construction. Regardless of whether a proprietary suspended ceiling system is expected to perform a fire resisting function, all suspended ceilings should be examined for their propensity to collapse under fire conditions and the effect of such a collapse on the fire safety strategy. All cavities created between the suspended ceiling and the structural floor assembly need to be controlled in extent and sub-divided by cavity barriers (see Data sheet 6.3.3) where necessary.

Fire performance data

As the fire performance of suspended ceilings is product specific, no general summary can be provided here.

1.7 Timber ceilings

Although unusual, such timber ceilings are used for compartment floors, e.g. when a timber compartment floor has exposed joists and is not underdrawn by a ceiling. Timber ceiling systems are restricted by their propensity for surface spread of flame and fire propagation. However, various treatments are available to enhance performance in this regard. Where the fire performance of a timber ceiling depends on such treatments, consideration should be given to their durability within the given environment and their compatibility with the substrate in question. Each timber species behaves differently.

Fire performance data

- **Fire resistance (integrity).** High propensity to shrinkage, cracking and charring when exposed to fire. The integrity of a timber ceiling depends on its thickness. (☆☆)
- **Temperature rise (insulation).** Timber is naturally insulating until it is fissured just prior to burn through. (☆)
- **Surface spread of flame.** Class 3 and combustible, unless treated chemically or physically coated. Verification of performance of the treated timbers shall be confirmed through testing, together with due consideration of long term durability of said treatments. (☆)
- **Smoke resistance.** If undamaged and well jointed, ceiling is relatively impermeable. (☆☆☆)
- **Loading and deflection**. Capable of withstanding reasonable deflections. (☆☆☆☆)
- **Ability to accommodate services.** Readily accommodates services, but support would be needed to restrain closing devices and sealing systems as the timber around the services becomes eroded. (☆☆)
- **Durability.** Not suitable for use in wet conditions, but generally may be considered durable and resistant to reasonable impacts. (☆☆☆☆)

1.8 Proprietary boards

A range of proprietary boards, including calcium silicate and cement based boards, may be used successfully in compartment floors to improve the fire performance. The verification of such systems is important. Workmanship and fixing are critical factors and the Fire Test, engineering assessment or Field of Application Report need to be studied in this regard.

Fire performance data

- **Fire resistance (integrity).** Generally good, especially for low density boards with a low propensity to cracking when heated. (☆☆☆☆☆)
- **Temperature rise (insulation).** Fair resistance to temperature increase, many board systems require an additional insulation contribution from the floor assembly. (☆☆☆)
- **Surface spread of flame.** Typically Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** If undamaged, proprietary board ceilings are relatively impermeable. Joints and edges may require special treatment as advised and proven by manufacturers. (☆☆☆☆☆)
- **Loading and deflection.** Only limited capacity to withstand deflection and design details will need to be given by a competent person to meet this requirement. (☆☆☆☆)
- **Ability to accommodate services.** Normally rigid enough to accept sealants around single services, but support will be needed to retain closing devices and sealing systems. (☆☆☆)
- **Durability.** Not suitable for use in wet conditions, but generally may be considered durable to reasonable impacts. (☆☆☆)

2. Structural supports

The principal contribution of the structural assembly to the fire performance of the compartment floor is in its provision of a load-bearing framework, upon which the upper and lower surfaces are fixed. The fire resistance of the structural assembly is determined through either testing or engineering assessment to BS 476: Part 21[1g], EN 1365 Part 2[27b], or appropriate structural fire engineering design by a competent person in accordance with the appropriate British Standard Code of Practice.

2.1 Timber assemblies

2.2 Steel assemblies

2.3 Concrete assemblies

2.1 Timber assemblies

The fire performance of timber structural members within a flooring system is a function of three variables:

Timber grade

Timber density

Cross-sectional size of the timber member.

Timber floor joists should be of sufficient size to enable them to retain their structural stability during the fire period. Allowance shall be made for the reduction in cross-sectional area of the members which will result from pyrolysis and charring of the members. Unless information to the contrary is available timber members should be assumed to be softwood and taken to char at a rate on all exposed surfaces of 0.66mm per minute of exposure to fire conditions. Hardwood timber members, i.e. higher density timbers generally those with a density > 650kg/m^3, can be taken to char at a lesser rate of 0.5mm per minute. On narrow sections the char rate is enhanced by the rounding of the exposed corners (arises) and the permitted increase in stress is reduced. Fire performance shall be demonstrated through appropriate structural design calculations to BS 5268: Part 4, Section 4.1[5a] where these factors are taken into account, or through satisfaction of the load-bearing criteria during test to BS 476: Part 21[1g], prEN 1365 Part 2[27b] in a floor with a similar level of protection, for the duration specified in Tables 2.1/2.2 of this *Design Guide*.

Fire performance data

- **Fire resistance performance (load-bearing capacity)**. Although timber is combustible, it burns at a relatively slow and determinate rate. It is possible to ascertain the load-bearing capacity of the charring section after a period of exposure to fire. High strength class materials generally lose loadbearing capacity faster than low grade timbers. Detailed calculations are described in BS 5268: Part 4, Section 4.1[5a]. Alternatively, assemblies whose fire resisting load-bearing capacity has been verified through testing or engineered assessment to BS 476: Part 21[1g], EN 1365 Part 2[27b] may be used. In practice, timber members need to be at least 38 mm thick to achieve a loadbearing fire resistance rating of 30 minutes. Timber sections generally become uneconomical for durations in excess of 90 minutes unless fully protected. (✩✩✩✩)
- **Surface spread of flame.** If the timber assembly is exposed on the underside, there is a need to control its propensity to surface flaming and fire propagation. Timber members achieve only a Class 3 surface spread of flame rating and are combustible, unless treated chemically or physically. Verification of performance of the treated timbers shall be confirmed through testing, together with due consideration of long term durability of said treatments. Some treatments can cause the char rate to increase. (✩)
- **Contribution to fire load.** Whilst being combustible the quantity of timber in a timber structural floor is usually low relative to the contents of the compartment formed and when protected by linings this cannot be released until after the lining has failed. (✩✩✩)

2.2 Steel assemblies

Steel loses its strength and stiffness at elevated temperatures. The fire resistance of steel structures is a function of the temperature reached within the steel and the load being carried. The applied loading, span, section size and support details are important influences on behaviour under fire conditions. Given the above information, it is possible to ascertain the load-bearing capacity of the heated steel assembly after a period of exposure to fire. Detailed calculations are described in BS 5950: Part 8[9]. Alternatively, assemblies whose fire resisting load-bearing capacity has been verified through testing or engineering assessment to BS 476: Part 21[1g], EN 1365 Part 2[27b] may be used.

Fire performance data

- **Fire resistance performance (load-bearing capacity).** Steel members lose strength as the temperature increases, but retain more than 50% of their tensile strength at temperatures up to 550°C. (☆☆☆☆)
- **Surface spread of flame.** Class 0 surface spread of flame and non combustible. (☆☆☆☆☆)
- **Contribution to fire load.** Steel makes no contribution to the fire load. (☆☆☆☆☆)

2.3 Concrete assemblies

Concrete loses its strength and stiffness at elevated temperatures. Concrete, however is a poor conductor of heat and this delays its temperature increase on exposure to fire conditions. The main influence on the fire resistance of a concrete floor system is the temperature reached within the reinforcing steelwork. This is controlled by the depth of concrete cover protecting the reinforcement. Other factors such as the degree of imposed load, span and support conditions do exert an influence and minimum cover specifications are related to these concrete floor details. One would normally expect concrete members with minimum cover depths of 25mm to achieve 30 minutes fire resistance and cover depths of 50mm to achieve 60 minutes fire resistance. Should concrete assemblies be used as a compartment floor above a space with a high combustibility fire load, e.g. hydrocarbon fuel stores, then in addition to fire resistance, the potential for destructive spalling of the floor needs to be considered. A specific fire test and/or expert advice may be necessary to quantify the hazard and identify protection measures. Guidance on the fire resistance of concrete floor slabs and floor assemblies is given in BS 8110:Part 2[13].

Fire performance data

Concrete assemblies form both the structural and separating function and therefore concrete assemblies are adjudged against all relevant criteria below.

- **Load-bearing.** Concrete members are capable of achieving substantial periods of fire resistance if correctly designed and detailed.(☆☆☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Contribution to fire load.** None. (☆☆☆☆☆)

3 In-fill materials

The fire performance of compartment floor systems may be upgraded and improved by incorporating insulating materials within the body of the floor structure. These materials reduce the flow of heat through the compartment floor and protect particular components within the floor assembly. For example, incorporation of an insulating layer within a floor assembly reduces the heat flow to the upper flow surface, thereby reducing the damage to the floor surface and increasing the level of protection to the unexposed surface.

The fitting of insulating infill offers a useful means of increasing the fire resistance of a compartment floor in a manner which does not intrude on the visual appearance of the floor. It is also a useful upgrading technique.

None of the in-fill materials contribute significantly to the fire load.

In order to be effective, infill materials must be distributed throughout the entire floor assembly, making suitable contact with the structural members to be protected. Particular care should be taken at cornices. Infilling materials may also increase sound insulation.

3.1 Inert granular dry pugging
3.2 Mineral wool
3.3 Concrete/ gypsum plaster

3.1 Inert granular dry pugging

Infill materials, e.g. crushed shells, will reduce the heat flow through the floor assembly and increase its fire resisting properties with respect to insulation. Granular infill, however relies on the lower surface of the floor or an intermediate lining, e.g. a pugging board, for support and once the lower surface (ceiling) fails under fire conditions, the contribution of a loose infill becomes ineffective.

Fire performance data

- **Fire resistance (integrity).** Poor integrity in its own right, relies on support from the ceiling membrane. (☆)
- **Temperature rise (insulation).** Good resistance to temperature rise. (☆☆☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** Permeable. (☆)
- **Loading and deflection.** Completely flexible. (☆☆☆☆☆)
- **Ability to accommodate services.** Cannot accept sealants around services, which would need to be sealed at the upper or lower floor surfaces. (☆)
- **Durability.** Durable. (☆☆☆☆☆)

3.2 Mineral wool

Mineral fibre insulation is suitable for provision of increased insulation within a compartment floor. Mineral fibre insulation is semi-rigid and may support its own weight. If mineral fibre in-fill is suitably fixed to the structural floor assembly, it may be considered to make a continuing contribution to the fire performance of the compartment floor, after the lowermost surface has failed and dropped away. Mineral fibre in-fill may be independently fixed with nails to the structural assembly or alternatively supported on expanded metal lath, which is itself supported by the structure, either by nails (min. 20mm long) or by suitable laying over a number of structural members. A range of proprietary in-fill materials are available and dependant on density and thickness, can make a valuable contribution to fire resistance.

Fire performance data

- **Fire resistance (integrity).** Good resistance to cracking. (☆☆☆☆☆)
- **Temperature rise (insulation).** Good resistance to temperature rise. (☆☆☆☆☆)

- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** Fairly impermeable. (☆☆)
- **Loading and deflection.** Flexible. (☆☆☆☆☆)
- **Ability to accommodate services.** Slab is typically rigid enough to accept sealants around services, but insufficiently stiff to restrain closing devices and sealing systems. (☆☆☆)
- **Durability.** Durable. (☆☆☆☆☆)

3.3 Concrete/gypsum plaster

The infilling of a floor system with lightweight concrete/gypsum plaster can significantly increase the fire resistance rating of the floor. Such infilling would typically only be needed for applications where 60 minutes fire resistance were required. The concrete/gypsum plaster infill is trowelled between the structural members onto an expanded metal lathing which is directly supported by the structure (using min. 20mm nails).

Fire performance data

- **Fire resistance (integrity).** Little propensity to cracking. (☆☆☆☆☆)
- **Temperature rise (insulation).** Good resistance to temperature rise. (☆☆☆☆☆)
- **Surface spread of flame.** Class 0 and limited combustibility. (☆☆☆☆☆)
- **Smoke resistance.** Completely impermeable. (☆☆☆☆☆)
- **Loading and deflection.** Withstands limited deflection. (☆☆☆)
- **Ability to accommodate services.** Rigid enough to accept sealants around services, but would need support to restrain closing devices and sealing systems. (☆☆☆☆)
- **Durability.** Durable. (☆☆☆☆☆)

4 Upper surface (flooring)

The upper surface of the compartment floor is typically the defining plane above which one is seeking to protect. The upper surface will obviously rely on the floor's structural assembly to remain in position and perform its function. Any anticipated fire performance by the upper surface is by definition limited by the performance of the structural floor assembly itself. The surface spread of flame characteristics of floors are not controlled in the *Design Guide* or regulations. Floor linings rarely make a significant contribution to fire load.

4.1 Timber floors (tongued and grooved boarding)
4.2 Timber floors (plain edged boarding)
4.3 Timber floors (sheeting)
4.4 Proprietary raised panelled floors

4.1 Timber floors (tongued and grooved boarding)

Well fitting tongued and grooved floor boarding, typically 21mm thickness, can provide useful protection against the transfer of heat and smoke under fire conditions.

Fire performance data

- **Fire resistance (integrity).** Propensity to shrinkage, cracking and charring when exposed to fire. The integrity of a timber floor depends on its effective thickness which is normally taken to be to the upper most face of the tongue. (✮✮✮)
- **Temperature rise (insulation).** Solid timber has an excellent resistance to temperature increase compromised by the gaps that develop after the tongues are burnt through. (✮✮✮)
- **Smoke resistance.** Tongued and grooved floors are relatively impermeable to cold smoke leakage whilst tightly jointed. (✮✮✮)
- **Loading and deflection**. Capable of withstanding reasonable deflections. (✮✮✮✮)
- **Ability to accommodate services.** Readily accommodates services. (✮✮✮✮)
- **Durability.** Durable and resistant to reasonable impacts. (✮✮✮✮✮)

4.2 Timber floors (plain edged boarding)

Square edged boarding is less able to restrict the transfer of smoke and hot gases. It can be upgraded through overlaying with not less than 3.2mm standard hardboard (Type S to BS 1142:Part 2) or 4mm plywood, nailed at 150mm centres, or other suitable membrane. The comments below relate to the non-upgraded construction.

Fire performance data

- **Fire resistance (integrity).** Propensity to shrinkage, cracking and charring when exposed to fire. The integrity of a timber floor depends on the thickness of the boards and the tightness of the board joints. (✮✮)
- **Temperature rise (insulation).** The excellent resistance to temperature increase is badly compromised by the gaps. (✮)
- **Smoke resistance.** Needs to be overdrawn if floor is to be impermeable. (✮)
- **Loading and deflection**. Capable of withstanding reasonable deflections. (✮✮✮✮)
- **Ability to accommodate services.** Readily accommodates services. (✮✮✮✮✮)
- **Durability.** Durable and resistant to reasonable impacts. (✮✮✮✮✮)

4.3 Timber floors (sheeting)

In order to carry the design loads across the common joist spans timber based sheet materials are normally at least 15mm thick. Joints need to be protected and sealed independently or by alignment with the floor's structural assembly.

Fire performance data

- **Fire resistance (integrity).** Propensity to shrinkage, cracking and charring when exposed to fire. The integrity of timber flooring depends on its thickness and the number of joints and how they are constructed. Most sheet materials will be tongued into each other giving a predictable integrity resistance until the tongue burns through. Backed up joints will not compromise the integrity rating. (✩✩✩✩)

- **Temperature rise (insulation).** Excellent resistance to temperature increase which is less compromised by the joints than with board materials. (✩✩✩)
- **Smoke resistance.** If joints are protected floor is impermeable to cold smoke. (✩✩✩✩✩)
- **Loading and deflection.** Capable of withstanding reasonable deflections. (✩✩✩✩✩)
- **Ability to accommodate services.** Readily accommodates services. (✩✩✩✩)
- **Durability.** Durable and resistant to reasonable impacts.(✩✩✩✩✩)

4.4 Proprietary raised panelled floors

Proprietary raised panelled floors need to be evaluated on an individual basis. Particular attention needs to be given to the cavity created between the floor and the structural floor below. Cavity barriers may be required to limit the potential spread of fire. Consideration may also need to be given to the structural stability of the raised floor given a fire within the cavity. Any calculation that they make to fire separation is not taken into account in the evaluation of a compartment floor.

Fire performance data

Proprietary systems to be evaluated on an individual basis.

Installation

The installation of compartment floors should be executed and completed by a suitably qualified person to the required standard appropriate to the system used. It is advisable that where fire performance is required then an inspection by an independent body may be carried out on the completed work.

Sources for further information

Association of Specialist Fire Protection, Association House, 253 Ash Road, Aldershot, Hampshire GU12 4DD.

EURISOL (UK Mineral Wool Association), 39 High Street, Redbourn, Herts AL3 7LW.

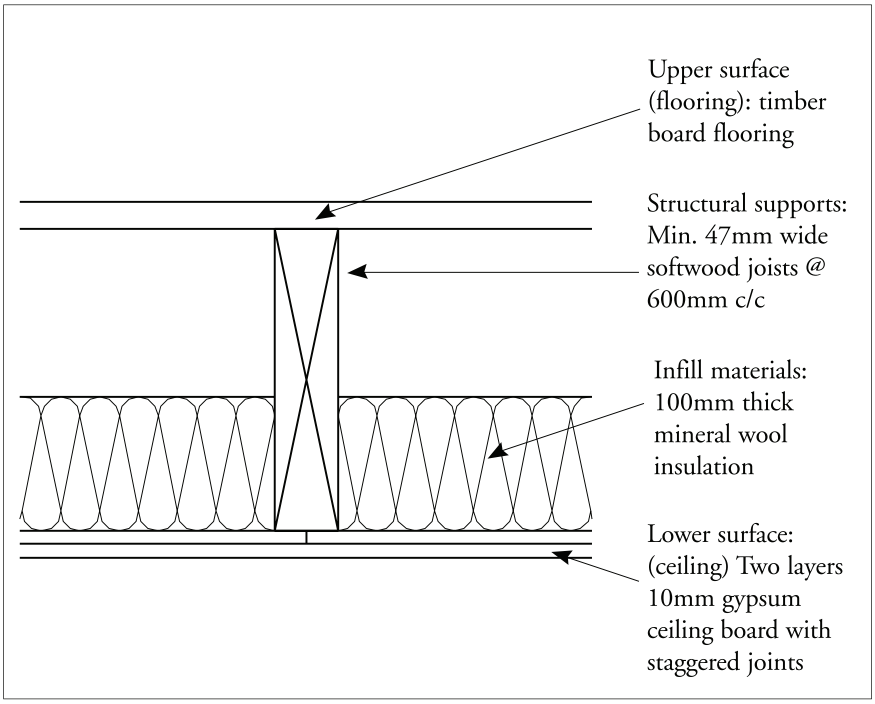

Figure 1. Typical 60 minute timber compartment floor with gypsum based board ceiling.

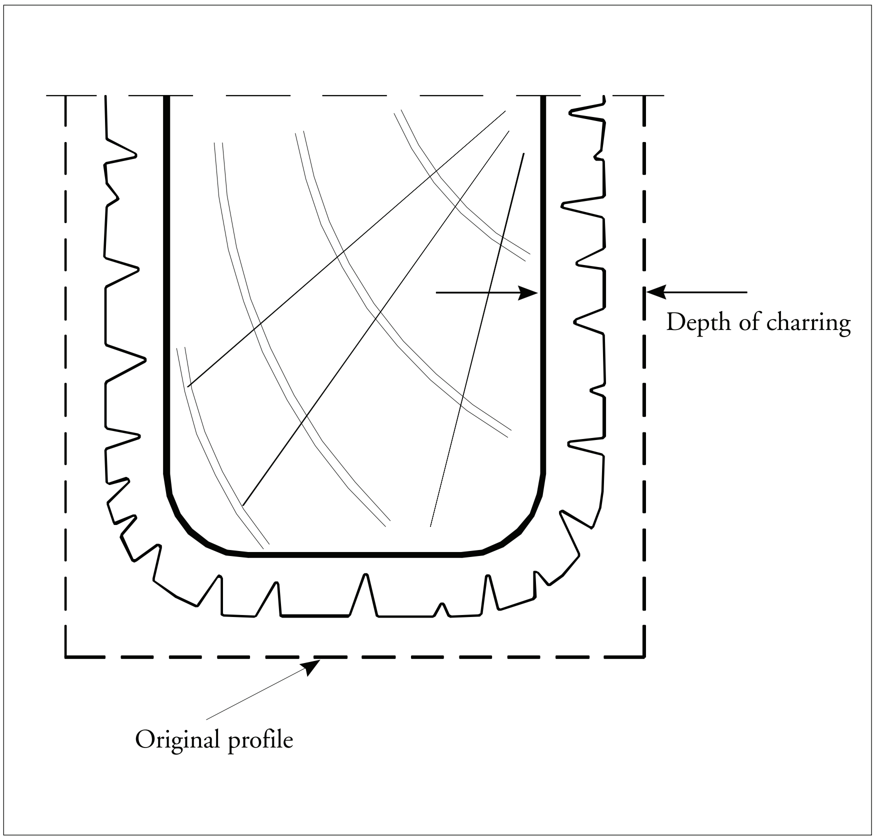

Figure 2. Rounding of arises by charring.

SUMMARY OF PERFORMANCE DATA

	Fire resistance (integrity)	Temperature rise (insulation)	Surface spread of flame	Smoke resistance	Loading and deflection	Ability to accommodate services	Durability	Fire resistance performance (loadbearing capacity)	Contribution to fire load
1. Lower surface (ceiling)									
1.1 Gypsum based boards and skim	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆	☆☆☆	☆☆☆	N/A	N/A
1.2 Lath and plaster	☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆	☆☆☆	N/A	N/A
1.3 Concrete	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	N/A	N/A
1.4 Permanent steel formwork	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	N/A	N/A
1.5 Wood wool shuttering	☆	☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆	☆☆☆	N/A	N/A
1.6 Proprietary suspended ceilings	*Proprietary systems to be evaluated on an individual basis.*								
1.7 Timber ceilings	☆☆	☆	☆	☆☆☆	☆☆☆☆	☆☆	☆☆☆☆	N/A	N/A
1.8 Proprietary boards	☆☆☆☆☆	☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆	☆☆☆	N/A	N/A
2. Floor components. Structural supports									
2.1 Timber assemblies	N/A	N/A	☆	N/A	N/A	N/A	N/A	☆☆☆☆	☆☆☆
2.2 Steel assemblies	N/A	N/A	☆☆☆☆☆	N/A	N/A	N/A	N/A	☆☆☆☆	☆☆☆☆☆
2.3 Concrete assemblies	N/A	N/A	☆☆☆☆☆	N/A	N/A	N/A	N/A	☆☆☆☆☆	☆☆☆☆☆
3. Floor components in-fill materials									
3.1 Inert granular dry pugging	☆	☆☆☆☆☆	☆☆☆☆☆	☆	☆☆☆☆☆	☆	☆☆☆☆☆	N/A	N/A
3.2 Mineral wool	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆	☆☆☆☆☆	☆☆☆	☆☆☆☆☆	N/A	N/A
3.3 Concrete/gypsum plaster	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆	☆☆☆☆	☆☆☆☆☆	N/A	N/A
4 Floor components upper surface (flooring)									
4.1 Timber floors (tongue and grooved boarding)	☆☆☆	☆☆☆	N/A	☆☆☆	☆☆☆☆	☆☆☆☆	☆☆☆☆☆	N/A	N/A
4.2 Plain edged boarding	☆☆	☆	N/A	☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	N/A	N/A
4.3 Timber floors (sheeting)	☆☆☆☆	☆☆☆	N/A	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	N/A	N/A
4.4 Propriety raised panel floor	*Proprietary systems to be evaluated on an individual basis.*								

Note: Although there is no requirement for controlling floor linings it would be expected that timber based materials would reflect their normal characteristics with respect to the surface spread of flame.